DOCUMENT RESUME

ED 359 263 TM 020 032

AUTHOR Perry, Patricia D.
TITLE High Dimensional Empirical Bayes Canonical/Interbattery Methods Applied in a Small Sample Survey of Adolescent Alcohol Use.
PUB DATE Apr 93
NOTE 30p.; Paper presented at the Annual Meeting of the American Educational Research Association (Atlanta, GA, April 12-16, 1993).
PUB TYPE Reports - Evaluative/Feasibility (142) -- Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Adolescents; Analysis of Covariance; *Bayesian Statistics; Correlation; *Drinking; Estimation (Mathematics); Factor Analysis; *Factor Structure; High Schools; *High School Students; Mathematical Models; Questionnaires; Regression (Statistics); Reliability; Research Design; *Sample Size; Surveys
IDENTIFIERS *Empirical Bayes Estimation; Self Report Measures; Student Surveys

ABSTRACT

Researchers have been limited in their ability to examine multiple constructs simultaneously due to the constraints imposed by traditional statistical methods. The most notable limitations include the need for a relatively large sample size while restricting the variables to a relatively small number. The application of a newly discovered statistical technique to overcome these limitations, namely, the use of weighted structural regression techniques to generate an empirical Bayes estimate of the covariance matrix as the starting point for a canonical correlation/interbattery factor analysis, is described. How availability of the new method affects research design and analysis is illustrated through a study of adolescent alcohol use. High school students (n=338) completed self-report measures of alcohol use and psychosocial mediators of alcohol use. The canonical correlation/interbattery factor analysis produced five factors, four of which were used for interpretation. The fifth factor did not contain any variable with a sufficient proportion of reliable variance within the criterion set. Analytic results provide extensive information about the reliability of individual items and the proportion of reliable variance of each item within the factor structure. The investigator was able to describe multiple relationships that emerged within the overall factor structure as well as the strength of those relationships. Two figures illustrate the discussion, and five tables show analysis data. (SLD)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
☑ This document has been reproduced as received from the person or organization originating it.
☐ Minor changes have been made to improve reproduction quality.
• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
Patricia D. Perry
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

ED359263

High Dimensional Empirical Bayes Canonical/Interbattery Methods Applied in a Small Sample Survey of Adolescent Alcohol Use

by

Patricia D. Perry, Ed.D., R.N.

Paper presented at American Educational Research Association Annual Meeting, Atlanta, GA., April 16, 1993.

Patricia D. Perry
Research Foundation for Mental Hygiene
194 Washington Avenue
Albany, NY 12210
(518) 473-7568

TM 020032

BEST COPY AVAILABLE

High Dimensional Empirical Bayes Canonical/Interbattery Methods Applied in a Small Sample Survey of Adolescent Alcohol Use

By

Patricia D. Perry, Ed.D., R.N.

The study of variables which can account for variance in substance use behavior constitutes an important field within social and behavioral research. While the complexity of such behavior is accepted, researchers have been limited in their ability to examine multiple constructs simultaneously due to the constraints imposed by traditional statistical methods. The most notable limitations include: (1) requiring a relatively large sample size to investigate relationships among multiple variables, and (2) restricting the variables under study to a relatively small number which are individually valid for the criterion as well as relatively independent of other variables.

This paper will describe the application of newly developed statistical techniques that overcome the previously described limitations of conventional analytic methods. More specifically, this paper will describe the use of weighted structural regression techniques to generate an empirical Bayes estimate of the covariance matrix as the starting point for a canonical correlation/interbattery factor analysis in a study of adolescent alcohol use. The paper will demonstrate how the availability of the new methods (as described in the previous papers) affects the strategies of research design, analysis and interpretation of

results. It will be shown that multiple constructs can be explored effectively even when the sample size is relatively small in relation to the number of variables, and that the use of an empirical Bayes estimation of the covariance matrix at the outset of a canonical correlation/interbattery factor analysis can have useful implications for social and behavioral research.

The study discussed in this paper entailed a survey of self-report measures of multiple alcohol use behaviors and psycho-social mediators of alcohol use. A questionnaire was developed by the investigator and administered to students (N=338) in seventeen health education classes within three suburban high schools during the spring of 1991 (Perry, 1992). The principal hypothesis was that a comprehensive set of psycho-social mediators of alcohol use would account for a substantial proportion of variance in alcohol use behaviors, and a set of self-reported motivations for use would constitute a non-ignorable subset of those psycho-social variables. It is important that the multidimensionality of the hypothesis be emphasized. While many investigations of adolescent alcohol use have explained the relationship of a limited number of psycho-social mediators of alcohol use to one criterion measure (usually confined to frequency and/or amount of alcohol use), few, if any, studies have investigated *simultaneously* the relationship among a comprehensive set of psycho-social mediators of use and a set of criterion variables which include frequency, amount, and context of alcohol use. This paper will describe how and why the use of

empirical Bayes estimation techniques and canonical correlation/interbattery factor analysis were an integral component in the design, analysis, and subsequent research findings of an exploratory study of multiple variables associated with adolescent alcohol use behaviors.

Research Design

Most research is designed according to the principles which stem from ordinary least squares regression applications. These principles include using as few predictor variables as possible while trying to ensure that each variable will be individually valid for the criterion and relatively uncorrelated with other predictors (Pruzek & Lepak, 1992). In contrast, due to the ability of empirical Bayes estimation techniques to capitalize on psychometric redundancy, the key design principles using these methods are to "observe as many regressor variables as content considerations or prior knowledge suggests are necessary to cover the reliable criterion variance" (Pruzek & Lepak, 1992, p. 125).

Following the previously described design principle, the DOMAIN formulation of substance use (Huba & Bentler, 1982) was used as an organizational framework to identify variables which could account for a substantial amount of variance in alcohol use behavior. The DOMAIN concept proposes that broad systems (i.e., biological, interpersonal, intrapersonal, and sociocultural systems) dynamically shape one another and influence the probability certain behaviors will be performed. Within each

broad system there are several domains of influence, each of which contains latent factors believed to effect behavior.

After the domains of influence most relevant to the study were identified, items were considered for inclusion on the questionnaire if they related directly to the research questions within the study. The items were selected and/or developed by the investigator following an extensive review of related literature. (Note: twenty items were taken from the Multidimensional Personality Questionnaire (Tellegen, 1982) with permission from the author.)

In addition, a set of criterion variables were generated which included context of use as an important component of the behavior itself. While most investigations of adolescent alcohol use have limited the behavior to be predicted to frequency and/or amount of alcohol use, the ability to examine the linear relationship between a set of predictor and criterion variables (in the context of canonical correlation) allows a more comprehensive description of the behavior itself to be investigated. It should be noted that while the language of prediction is used throughout the discussion, it is used only to identify the sets of variables and no causal relationship is intended by the use of such terms.

An overview of the organizational framework used in the study is presented in Figure 1. The set of predictor variables includes variables from eleven domains of influence (i.e., Organismic Status, Psychological Status, Behavioral Styles,

etc.), while the criterion variables include frequency, amount, and context of alcohol use. Within each of the domains of influence, several categories of variables are listed. Each variable category contains individual measures which were the actual items on the questionnaire. For example, Huba and Bentler (1982) suggest that Psychological Status is a domain of influence on substance use behavior. Within the present investigation, four categories of variables (negative affect, positive affect, control vs. impulsivity, and alienation) within the Psychological Status Domain were considered to be germane to the research questions. Each variable category contained three or more indicators which became the individual items on the questionnaire. The intent was to have the individual items within each variable category combine empirically to form composite variables analogous to the variable categories within each domain of influence. The final questionnaire contained 202 items within 38 categories of variables.

Thus a survey instrument was designed explicitly to incorporate a sufficient number of items to account for a substantial proportion of variance in adolescent alcohol use behaviors. This design principle is in sharp contrast to the more traditional principle which would have based the selection of variables on their psychometric properties and limited their number according to the sample size.

Data Analysis

The data analysis consisted of three processes: (1) preparing the variables for analysis, (2) canonical correlation/interbattery factor analysis, and (3) intra-battery factor adjustments. Each of these processes will be presented in more detail in an effort to describe the analytic strategy utilized in the study.

a. Preparing the Variables for Analysis

Preparing the variables for analysis entailed generating a more manageable number of composite measures while never combining item variables which appeared to be empirically or theoretically distinct. To achieve this aim, results of a common factor analysis were used to combine items into a single composite variable if, and only if, the items had comparable factor loadings (i.e., similar size and corresponding directional sign) and they represented theoretically similar constructs. (Note: the number of common factors was determined using an index (ICOMP) for model comparison based on information theory - Bozdogan, 1990.) This process produced sixty-six predictor variables.

While the original framework proposed that individual variables would combine within categories of variables, the results of the data preparation process produced different outcomes. Many variables remained unique items, some combined in the predicted direction, while others combined into unexpected

composite variables. The most notable differences between the proposed composites and the empirically derived composites emerged within the motivations for use subset of variables. It was proposed that the twenty-one items that measured motivations for use would combine into four categories of variables (to enhance positive affect, to minimize negative affect, enhance sociability, and curiosity) as listed in Table 1. However, as can be seen in Table 2, the results of the data preparation process generated four composite measures from ten motivation for use variables, leaving the remaining eleven motivation for use variables as single items for the canonical correlation interbattery analysis.

The results of the data preparation phase can be seen in Figure 2 which shows the variable labels for sixty-six predictor variables used in the canonical correlation/inter-battery factor analysis. Some of the variables represent composite variables, while others represent single items. (A list of the items that correspond to the variable labels is available from the author.) For theoretical reasons, the twenty criterion items which measured frequency, amount, and context of alcohol use were not combined into composite variables.

The data preparation phase also entailed excluding outlier cases and limiting the subsequent canonical correlation/inter-battery factor analysis to self-reported alcohol users (N=288). Thus, prior to the canonical correlation/interbattery factor analysis, the data were prepared by creating composite measures

while retaining empirical item distinguishability. This process resulted in eighty-six variables (20 criterion variables and 66 predictor variables) with 288 cases for the canonical correlation/inter-battery factor analysis.

b. Canonical Correlation/Interbattery Factor Analysis

The primary analytic task within the present study was to examine and interpret linear relationships between variables in the predictor and criterion sets. Utilizing the methods described in the previous papers, a correlation matrix analog which resulted from the convex sum of a model-free estimate and a model-based estimate of the population correlation matrix was used as the starting point for the canonical correlation/inter-battery analysis. The value of w (i.e., the scalar used to compute the convex sum) was .73 for the principal analysis which incorporated five common factors. This value of w, based on evidence from the sample, indicates the convex sum correlation matrix was weighted toward a model-free estimate of the correlation matrix rather than a model-based estimate.

The theoretical justification for the present analysis is based on the work of Michael Browne (1979). In a seminal paper, Browne (1979) described the theoretical and mathematical link between canonical correlation and interbattery factor analysis. Most important for the present investigation is the concept that canonical correlation creates weights which maximize the correlation between the predictor and criterion sets derived from

each set separately, (i.e., the linear combination using information from R_{11} and R_{22}). By comparison, interbattery factor analysis attempts to produce weights which maximize the correlation between the predictor and criterion sets derived from the joint predictor-correlation matrix R_{21}. As a result, interbattery factor analysis examines the common latent variable sources of variation for both set one and set two simultaneously.

Therefore, the present analysis represents the use of an empirical Bayes estimate of the covariance-correlation matrix as the starting point for a canonical correlation/interbattery factor analysis described by Browne. It is important to note that all procedures described thus far in the analytic strategy (including the data preparation procedures) represent scale-free methods of data analysis. Scale-free methods remove the arbitrariness of the correlation metric; the essential results are invariant to the metric used for interpretation.

In addition to the previously described analytic strategy, two other procedures were used to enhance the stability and interpretability of the analysis. These include an adjustment to the factors to improve fit of the interbattery factor coefficient matrices to the respective within battery correlation sets, and a simple structure normal varimax rotation of the factor coefficients which resulted from the canonical correlation/interbattery analysis. The factor adjustment procedure will be described in more detail since it represents a non-conventional approach in the context of this analysis.

c. Intra-Battery Factor Adjustments

Interbattery factor analysis is similar to common factor analysis in that it produces a matrix of factor coefficients represented as F_{IB}. The interbattery factors are generally computed without regard for the intra-set information in R_{11} and R_{22}. The adjustments consisted of seeking a constant, k1, that would jointly minimize the sum of the squared differences in the off-diagonal fit of $k1*s1*F_1F_1'$ to R_{11} and $(1/k1)*s1*F_2F_2'$ to R_{22} (Pruzek, Personal Communication, 1992). (Note: s1 and s2 were constants chosen as p1*(p1-1) and p2*(p2-1) respectively. They represent the counts of the number of unique off-diagonal correlation or covariance coefficients within the respective sets.)

The adjustments can be diagrammed as

$$F_{IB} * F_{IB}' = \begin{bmatrix} F_1F_1' & -- \\ & \\ -- & F_2F_2' \end{bmatrix} \text{ adjusted to improve fit to } \begin{bmatrix} R_{11} & -- \\ & \\ -- & R_{22} \end{bmatrix}$$

Table 3 contains the correlation matrix for the transformed canonical system. The canonical correlation analogs for the five factors are highlighted within the matrix. As can be seen, the

factor adjustment process produced small non-zero off-diagonal correlations among the transformed or correlated variates. The value of the multipliers for the factor coefficient matrices was .948 for F_1 and 1.055 for F_2.

d. Summary of Analysis

The canonical correlation/interbattery factor analysis produced five factors, four of which were used for interpretation. The substantive results of the analysis are presented in Tables 4 and 5. Table 4 contains the factor coefficients (multiplied by 100) which resulted from the canonical correlation/interbattery factor analysis. Also included in Table 4 are the communality estimates (h^2) for each variable. These communality estimates can be regarded as proportions of reliable variance for each variable within the rotated interbattery factor system.

Table 5 contains the proportions of reliable variance for each variable for each factor, as well as the corresponding variable communality estimates. From Table 5 it can be seen that the BEER30 variable (which is the amount of beer use in the last 30 days) had an h^2 value of .63, and the communality was distributed among the factors such that 57% is attributed to Factor I, 28% to Factor II, 1% to Factor III, 5% to Factor IV, and 8% to Factor V. Note that in Table 5 the row sums are equal to 100% (within rounding error). These results suggest that a substantial amount of variance in the BEER30 variable was

accounted for within the interbattery factor structure, and that the greatest proportion of that variance was attributable to the first two factors.

Variables were selected for interpretation of the factor if they had sufficient proportion of reliable variance within the factor (Table 5) as well as sufficient factor coefficient values (Table 4). The criteria for "sufficient" varied for each factor and was dependent on the amount of variance accounted for by each factor. Factors accounting for greater amounts of variance had more stringent criteria, while lesser factors had more relaxed criteria for interpretation. Variables selected for interpretation on the strongest factor had a reliable proportion of variance >.50 and a corresponding factor coefficient >.50, while variables selected for interpretation on the weakest factor had a reliable proportion of variance >.25 and a corresponding factor coefficient >.30. (Note: the fifth factor did not contain any variables with a sufficient proportion of reliable variance within the criterion set, therefore it was not included in the discussion of the results.)

Interpretation of Results

The analytic procedures described previously produced results that had significant implications for the reporting and interpretation of the research findings. For example, the results of the analysis suggested that several theoretical perspectives on adolescent alcohol use could explain some of the variance in behavior, but none could explain all of the variance. The expectation that multiple theories of adolescent alcohol use are needed to explain variance in behavior was confirmed, but more importantly, the context in which each theory could be used to explain that variance was further refined. A brief example of the substantive findings will illustrate the potential importance of this issue.

The finding that adolescents initiate alcohol use prior to initiating marijuana use (Kandel & Faust, 1975), and the link between social deviance and adolescent substance use (Jessor & Jessor, 1977) has been well established in the literature. Examination of the factor structure in this study suggested a dimension of individual difference related to alcohol and marijuana users, social use of alcohol, and motivations to use alcohol that included a desire to minimize negative affect. Another factor substantiated the link between adolescent deviance and alcohol and marijuana use. Still another factor suggested a dimension of individual difference in alcohol use associated with psychological distress that was unrelated to whether an adolescent used marijuana or engaged in social deviance. Thus

three dimensions of alcohol use emerged in which two dimensions were expected based on previous research, but for which there was little to predict the existence of the third factor (i.e., a psychological distress factor which was unrelated to increased involvement with substances or social deviance). The findings suggest that while stage of use and social deviance are important explanations for the relationships that emerged on the factors, there exists another dimension of individual difference that was unrelated to and unexplained by these two theoretical perspectives.

In a similar fashion, there was an lack of emergence of an expected factor within the overall analysis. Considering the extensive amount of research which suggests that adolescents initiate alcohol use for social/recreational reasons, there was no unique factor that represented this dimension of individual difference. The social/recreational factor was indeed the strongest factor within the analysis, but it was related to increased involvement with substances and motivations for use which included a desire to minimize negative affect. This finding suggests that "normative" adolescent alcohol use (i.e., using alcohol for social/recreational purposes without overt risk for developing subsequent problems with alcohol) may be less salient in describing variance in adolescent alcohol use than previously hypothesized.

The availability of the communality value for each variable and its corresponding proportion of reliable variance for each

factor also contributed the interpretation of the factors. For example, the third factor was labeled the "psychological distress" factor due to: (1) the presence of a negative association with the social closeness variable, and (2) the cluster of variables that had a large proportion of reliable variance attributed to the factor but lacked sufficient factor loadings to be used for interpretation of the factor (e.g., family stress, discord, parental support, negative affect and positive affect - see Table 5). The proportion of reliable variance suggests that if these items had greater communality values, they would have had greater factor coefficients on this factor.

The previous examples were selected to illustrate the potential richness of data interpretation that resulted from this analysis. A complete description of the results are described elsewhere (Perry, 1992). The essential consideration for this paper is that the analytic procedures described previously produced a vast amount of information that can be used to confirm previous research, extent previous research, and suggest new relationships among variables that were not previously reported.

Conclusion

This paper described the practical implications of the use of weighted structural regression techniques as the starting point for a canonical correlation/interbattery factor analysis in a small sample survey of adolescent alcohol use. The use of such

methods were found to have implications for the design of the study such that the investigator could include a sufficient number of variables to account for a substantial amount of variance in behavior. The analytic results provided an extensive amount of information regarding the reliability of individual items and the proportion of reliable variance of each item within the factor structure. Using that information for interpretation of the factors, the investigator was able to describe multiple relationships that emerged within the overall factor structure as well as the strength of those relationships. Given the complexity of a behavior such as adolescent alcohol use, the statistical techniques described in this paper seemed particularly well suited for an exploratory study of such behavior.

References

Bozdogan, H. (1990). On the information-based measure of covariance complexity and its application to the evaluation of multivariate linear models. Communications in Statistics, Theory and Methods, 19(1), 221-278.

Browne, M. W. (1979). The maximum-likelihood solution in inter-battery factor analysis. British Journal of Mathematical and Statistical Psychology, 32, 75-86.

Huba, G. J, & Bentler, P. M. (1982). A developmental theory of drug use: derivation and assessment of a causal modeling approach. In P. B. Baltes, & O. G. Brim, Jr. (Eds.), Life-Span Development and Behavior (pp.147-203). New York: Academic Press.

Jessor, R. & Jessor, S. L. (1977). Problem behavior and Psychosocial Development - A Longitudinal Study of Youth. New York: Academic Press.

Kandel, D. B., & Faust, R. (1975). Sequence and stages in patterns of adolescent drug use. Archives of General Psychiatry, 32, 923-932.

Perry, P. D., (1992) Adolescent Alcohol use: A study of self-reported motivations and other psycho-social mediators of alcohol use among high school students.

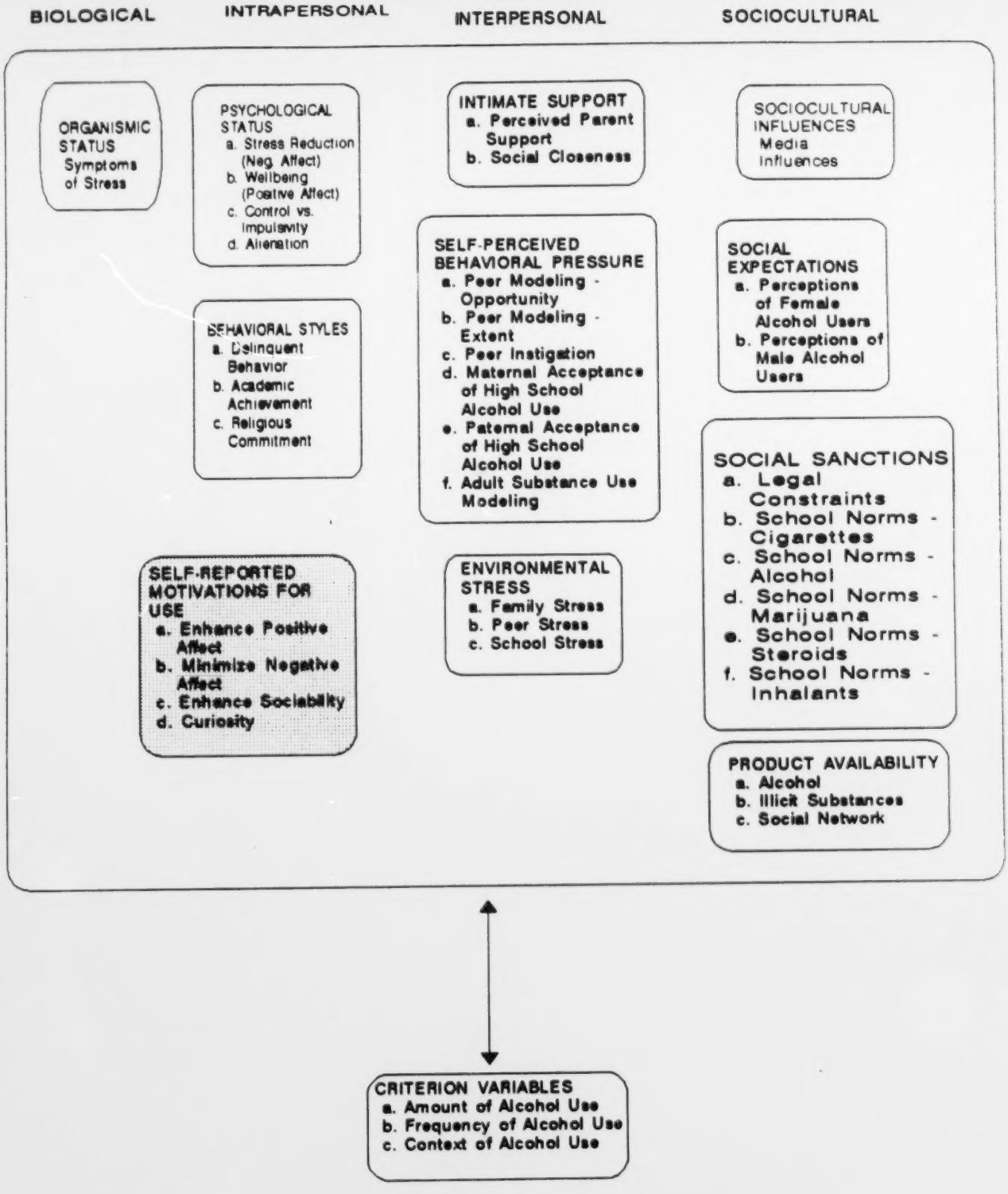
Pruzek, R. M., & Bozdogan, H. (1991). A theory-based method for small factor analysis and choosing the number of factors. Paper presented at the annual meeting of the Psychometric Society, Rutgers University, NJ.

Pruzek, R. M., & Lepak, G. M. (1992). Weighted structural regression: A broad class of adaptive methods for improving linear prediction. Multivariate Behavioral Research, 27, 95-129.

Tellegen, A. (1982). Brief Manual for the Differential Personality Questionnaire. Unpublished manuscript, University of Minnesota.

Figure 1

Proposed Organizational Framework Adapted from Huba and Bentler (1982)



BEST COPY AVAILABLE

Figure 2

Modified Organizational Framework

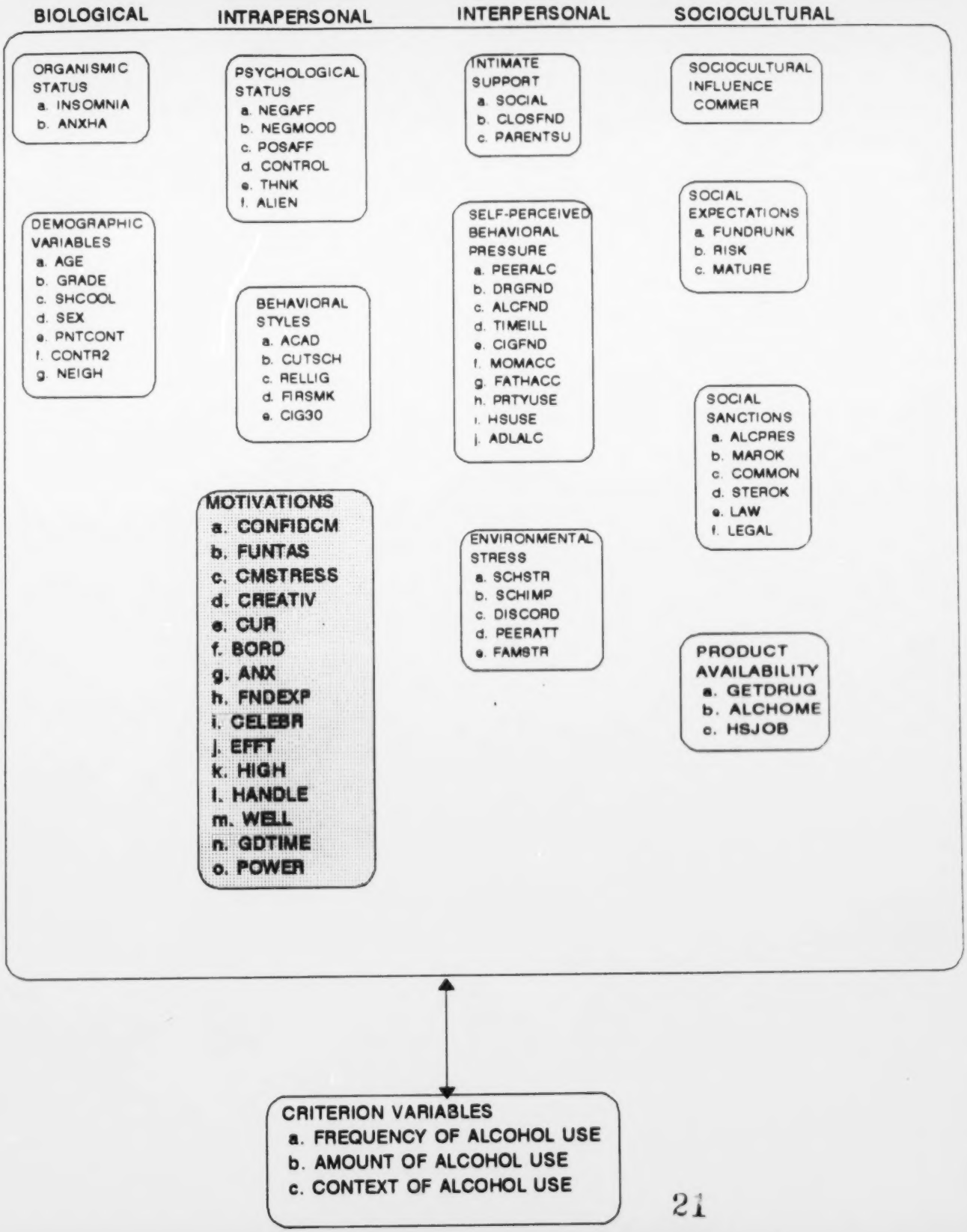


Table 1

Proposed Variable Composites for

Self-Reported Motivations for Alcohol Use

VARIABLE CATEGORY:
Enhance Positive Affect

INDICATORS:
1. to feel more creative.
2. to celebrate when I was in a good mood.
3. to have fun with my friends.
4. to create a feeling of well-being.
5. because it tasted good.

VARIABLE CATEGORY:
Minimize Negative Affect

INDICATORS:
1. because I was bored.
2. because I was angry or frustrated.
3. because I was anxious or tense and it helped me to relax.
4. to get out of a depressed mood.
5. to manage a stressful situation.
6. to feel more powerful.

VARIABLE CATEGORY:
Sociability

INDICATORS:
1. to overcome feelings of being shy around other people.
2. because my friends expected me to drink.
3. to get along better with friends.
4. to have a good time.
5. to gain more confidence in a social situation.

VARIABLE CATEGORY:
Curiosity

INDICATORS:
1. because I was curious and I wanted to see what it was like.
2. to see if I could "handle it".
3. to gain deeper insight into myself.
4. to see what effect I could get from it.
5. to get high.

Table 2

Empirically Derived Variable Composites

for Self-Reported Motivations for Alcohol Use

VARIABLE DOMAIN - Self-Reported Motivations for Use	
Mnemonic Label	Indicators
	How often have you used alcohol:
CONFIDCM	1a. to gain more confidence in a social situation? 1b. to overcome feelings of being shy around other people? 1c. to get along better with friends?
FUNTAS	2a. because it tasted good? 2b. to have fun with my friends?
CMSTRESS	3a. because I was angry or frustrated? 3b. to get out of a depressed mood? 3c. to manage a stressful situation?
CREATIV	4a. to gain deeper insight into myself? 4b. to feel more creative?
CUR	5. because I was curious and wanted to see what it was like?
BORD	6. because I was bored?
ANX	7. because I was anxious or tense and it helped me to relax?
FNDEXP	8. because my friends expected me to drink?
CELEBR	9. to celebrate when I was in a good mood?
EFFT	10. to see what effect I could get from it?
HIGH	11. to get high?
HANDLE	12. to see if I could "handle it"?
WELL	13. to create a feeling of well-being?
GDTIME	14. to have a good time?
POWER	15. to feel more powerful?

Table 3

Correlation Matrix for the Transformed Canonical System

Canonical Variates	1	2	3	4	5	6	7	8	9	10
1	1.00									
2	.00	1.00								
3	.00	.00	1.00							
4	.00	.00	.00	1.00						
5	.00	.00	.00	.00	1.00					
6	**.92**	.04	.05	.04	.02	1.00				
7	.04	**.63**	.04	.03	.05	.00	1.00			
8	.05	.04	**.57**	.02	-.01	.00	.00	1.00		
9	.04	.03	.02	**.54**	.00	.00	.00	.00	1.00	
10	.03	.05	-.01	.00	**.52**	.00	.00	.00	.00	1.0

Table 4

Varimax Rotated Matrix of Inter-Battery Factor Coefficients**

Variables Nos./Name	Inter-Battery Factors 1	2	3	4	5	h^2
CRITERION VARIABLES						
Frequency of Use						
1: BEER30	60*	42*	8	18	22	63
2: WINE30	41	22	-10	34*	-10	35
3: LIQ30	50*	36*	7	20	- 8	43
4: BEER12	72*	22	4	11	23	64
5: WINE12	55*	14	- 7	37*	-16	48
6: LIQ12	68*	30*	6	17	-11	61
7: ALCLEV	67*	31*	1	22	14	61
Amount of Use						
8: ALCHI	64*	5	14	- 3	-10	45
9: ALCOCC	79*	3	5	4	9	63
10: ALC2DNK	51*	34*	4	17	10	42
11: ALC6DNK	55*	42*	22	12	7	55
Context of Use						
12: PRTY	85*	- 6	0	- 0	9	74
13: ALSCH	53*	38*	31	3	3	52
14: ROOM	28	- 4	41*	31*	- 4	34
15: CAR	49	19	0	8	9	29
16: ATHOME	7	-11	8	49*	17	29
17: WORK	27	2	46*	2	- 2	29
18: BEER30/ PRTY	10	60*	9	10	18	42
19: ALCLEV/ ALCOCC	19	50*	9	13	12	33
20: WINE30/ ROOM	- 6	12	23	31*	6	17

(table continues)

Table 4 (cont.)

Variables Nos./Name	Inter-Battery Factors 1	2	3	4	5	h^2
PREDICTOR VARIABLES						
Self-Reported Motivations for Use						
21: CONFIDCM	52*	4	20	5	1	32
22: FUNTAS	87*	- 3	5	20	2	80
23: CMSTRESS	59*	7	34	13	- 3	48
24: CREATIV	45	11	23	18	- 6	30
25: CUR	44	-27	10	3	- 6	28
26: BORD	52*	5	36*	14	-19	46
27: ANX	61*	5	32	11	- 3	49
28: CELEBR	74*	5	9	17	9	59
29: EFFT	54*	-17	19	-12	- 4	37
30: HIGH	68*	15	21	- 9	2	53
31: HANDLE	35	- 5	26	8	2	20
32: WELL	51*	11	31*	4	6	37
33: FNDEXP	27	- 4	20	- 3	0	12
34: GDTIME	90*	- 8	4	- 5	6	83
35: POWER	45	2	30*	5	-10	31
Psycho-Social Mediators						
36: LAW	-50*	-32*	-10	- 3	6	37
37: LEGAL	-61*	4	3	- 0	- 3	38
38: ALCPRES	5	14	12	0	5	4
39: MAROK	34	6	10	-11	-10	15
40: COMMON	35	18	12	- 1	- 0	17
41: STEROK	5	6	20	-10	10	6
42: ACAD	-35	-22	-24	7	- 8	24
43: CUTSCH	46	30*	18	1	16	36
44: RELIG	-18	- 6	-16	-10	- 3	7
45: FIRSMK	35	10	12	- 1	6	15
46: CIG30	44	32*	24	- 2	20	40
47: COMMER	5	14	7	2	-11	4
48: GETDRUG	51*	21	5	6	- 3	32
49: ALCHOME	- 3	- 0	7	35*	7	14
50: HSJOB	19	- 1	0	1	5	4
51: FUNDRUNK	50*	17	26	10	8	36
52: RISK	7	13	- 2	- 6	5	3
53: MATURE	35	11	18	5	15	19

(table continues)

Table 4 (cont.)

Variables Nos./Name	Inter-Battery Factors 1	2	3	4	5	h^2
PREDICTOR VARIABLES						
Psycho-Social Mediators						
54: PEERALC	72*	12	7	10	14	57
55: DRGFND	35	40*	14	8	- 7	31
56: ALCFD	72*	16	- 1	- 3	14	57
57: TIMEILL	63*	43*	13	2	5	60
58: CIGFND	56*	17	15	2	13	38
59: MOMACC	9	- 1	4	10	27	9
60: FATHACC	10	12	11	0	25	10
61: PRTYUSE	30	16	1	28	27	27
62: HSUSE	12	5	6	4	24	8
63: ADLALC	6	8	2	39*	- 3	17
64: SCHSTR	17	3	14	- 4	-18	8
65: SCHIMP	17	3	26	7	- 2	10
66: FAMSTR	13	8	28	15	-16	15
67: DISCORD	-13	-18	18	10	1	9
68: PEERATT	- 9	2	- 0	12	1	2
69: SOCIAL	21	8	-14	- 8	5	8
70: CLSFND	7	- 5	-39*	6	- 5	17
71: PARENTSU	- 6	- 6	-27	-15	- 6	11
72: NEGAFF	8	-11	11	0	-15	5
73: NEGMOOD	10	-13	18	- 1	- 2	6
74: POSAFF	- 5	7	-10	- 0	- 2	2
75: CONTROL	-16	- 5	- 2	10	1	4
76: THNK	- 7	- 4	-15	2	9	4
77: ALIEN	- 2	4	23	- 3	-14	7
78: INSOMNIA	- 4	3	17	- 5	- 9	4
79: ANXHA	- 5	- 2	5	11	- 1	2
Demographic Variables						
80: AGE	20	25	- 4	8	22	16
81: GRADE	20	26	- 8	4	27	19
82: SCHOOL	- 8	-10	4	2	-16	5
83: SEX	3	- 4	-40*	2	-24	22
84: PNTCONT	15	- 3	13	7	- 1	5
85: CONTR2	58*	45*	12	9	0	56
86: NEIGH	2	1	1	- 0	13	2

* Denotes variables used to interpret the factor
**All entries multiplied by 100

Table 5

Proportions of Reliable Variance
for Each Variable for Each Factor**

Variables Nos./Name	Inter-Battery Factors 1	2	3	4	5	h^2
CRITERION VARIABLES						
Frequency of Use						
1: BEER30	57	28	1	5	8	63
2: WINE 30	48	14	3	33	3	35
3: LIQ30	58	30	1	9	1	43
4: BEER12	81	8	0	2	8	64
5: WINE12	63	4	1	29	5	48
6: LIQ12	76	15	1	5	2	61
7: ALCLEV	74	16	0	8	3	61
Amount of Use						
8: ALCHI	91	1	4	0	2	45
9: ALCOCC	99	0	0	0	1	63
10: ALC2DNK	62	28	0	7	2	42
11: ALC6DNK	55	32	9	3	1	55
Context of Use						
12: PRTY	98	0	0	0	1	74
13: ALSCH	54	28	18	0	0	52
14: ROOM	23	0	49	28	0	34
15: CAR	83	12	0	2	3	29
16: ATHOME	2	4	2	83	10	29
17: WORK	25	0	73	0	0	29
18: BEER30/ PRTY	2	86	2	2	8	42
19: ALCLEV/ ALCOCC	11	76	2	5	4	33
20: WINE30/ ROOM	2	8	31	57	2	17

(table continues)

Table 5 (cont.)

Variables Nos./Name	Inter-Battery Factors 1	2	3	4	5	h^2
PREDICTOR VARIABLES						
Self-Reported Motivations for Use						
21: CONFIDCM	85	1	13	1	0	32
22: FUNTAS	95	0	0	5	0	80
23: CMSTRESS	73	1	24	4	0	48
24: CREATIV	68	4	18	11	1	30
25: CUR	69	26	4	0	1	28
26: BORD	59	1	28	4	8	46
27: ANX	76	1	21	2	0	49
28: CELEBR	93	0	1	5	1	59
29: EFFT	79	8	10	4	0	37
30: HIGH	87	4	8	2	0	53
31: HANDLE	61	1	34	3	0	20
32: WELL	70	3	26	0	1	37
33: FNDEXP	61	1	33	1	0	12
34: GDTIME	98	1	0	0	0	83
35: POWER	65	0	29	1	3	31
Psycho-Social Mediators						
36: LAW	68	28	3	0	1	37
37: LEGAL	98	0	0	0	0	38
38: ALCPRES	6	49	36	0	6	4
39: MAROK	77	2	7	8	7	15
40: COMMON	72	19	8	0	0	17
41: STEROK	4	6	67	17	17	6
42: ACAD	51	20	24	2	3	24
43: CUTSCH	59	25	9	0	7	36
44: RELIG	46	5	37	14	1	7
45: FIRSMK	82	7	10	0	2	15
46: CIG30	48	26	14	0	10	40
47: COMMER	6	49	12	1	30	4
48: GETDRUG	81	14	1	1	0	32
49: ALCHOME	1	0	4	87	4	14
50: HSJOB	90	0	0	0	6	4
51: FUNDRUNK	69	8	19	3	2	36
52: RISK	16	56	1	12	8	3
53: MATURE	64	6	17	1	12	19

(table continues)

Table 5 (cont.)

Variables Nos./Name	Inter-Battery Factors 1	2	3	4	5	h^2
PREDICTOR VARIABLES						
54: PEERALC	91	3	1	2	3	57
55: DRGFND	40	52	6	2	2	31
56: ALCFD	91	4	0	0	3	57
57: TIMEILL	66	31	3	0	0	60
58: CIGFND	83	8	6	0	4	38
59: MOMACC	9	0	2	11	81	9
60: FATHACC	10	14	12	0	63	10
61: PRTYUSE	33	9	0	29	27	27
62: HSUSE	18	3	4	2	72	8
63: ADLALC	2	4	0	89	1	17
64: SCHSTR	36	1	25	2	40	8
65: SCHIMP	29	1	**68**	5	0	10
66: FAMSTR	11	4	**52**	15	17	15
67: DISCORD	19	36	**36**	11	0	9
68: PEERATT	40	2	0	72	1	2
69: SOCIAL	55	8	25	8	3	8
70: CLSFND	3	1	89	2	1	17
71: PARENTSU	3	3	**66**	20	3	11
72: NEGAFF	13	24	24	0	45	5
73: NEGMOOD	17	28	**54**	0	1	6
74: POSAFF	13	25	**50**	0	2	2
75: CONTROL	64	6	1	25	0	4
76: THNK	12	4	**56**	1	20	4
77: ALIEN	1	2	**76**	1	28	7
78: INSOMNIA	4	2	**72**	6	20	4
79: ANXHA	13	2	13	60	1	2
Demographic Variables						
80: AGE	25	39	1	4	30	16
81: GRADE	21	36	3	1	38	19
82: SCHOOL	13	20	3	1	51	5
83: SEX	0	1	73	0	26	22
84: PNTCONT	45	2	34	10	0	5
85: CONTR2	60	36	3	1	0	56
86: NEIGH	2	1	1	0	85	2

**All entries multiplied by 100
Note: All entries sum to one by row.